A. Beaumont . M.A.

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SEALE-HAYNE AGRICULTURAL COLLEGE

NEWTON ABBOT, DEVON.

DEPARTMENT OF PLANT PATHOLOGY

NINTH ANNUAL REPORT

FOR THE YEAR ENDING SEPTEMBER 30th, 1932.

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Ninth Annual Report of the Department of Plant Pathology.

ADVISORY WORK.

Statistics of advisory letters and visits are as follows :—

Advisory Letters.	*Entomological.*	*Mycological.*
Devon	125	161
Cornwall	87	74
External	21	59
Total	233	294
Advisory Visits.		
Devon	143	110
Cornwall	83	61
Total	226	171

LECTURES.

In the College the usual courses were given, and the Entomologist gave lectures and demonstrations at the Short Course in Beekeeping. External lectures were given by the Entomologist at

Plymouth	Insect Pests.
Torquay	do.
Penzance	do.
Dawlish	Violet Aphis.

The Entomologist was one of the judges at the Imperial Fruit Show at Manchester.

External lectures by the Mycologist were given at

Torquay	Garden Fungi.
Penzance	Bulb Diseases.
Liverton Women's Institute	Bulb Growing.

A paper on " The Weather and Potato Blight " was given at the Agricultural Meteorology Conference in South Kensington.

SHOWS.

As before exhibits were staged at the Commercial Horticultural Shows in Penzance in March and Plymouth in April, and at the Royal Horticultural Society's Flower Show at Chelsea in May. Specimens were sent to the Newton Abbot Allotment Society's Show.

POTATO " SICKNESS."

Potato " Sickness," with which is closely associated an eelworm, *Heterodera Schachtii*, has been present for the last two years on allotments at Sidmouth. In addition to eelworm there are other factors present not fully understood. During the year fresh centres of infection have occurred in South and North Devon. Potato " sickness " is also severe in parts of the early potato-growing area of West Cornwall, this important industry therefore being threatened.

A study of the conditions under which the trouble occurs and experiments for its control are in progress in the two counties concerned in collaboration with the Advisory Chemist and the County authorities. All growers who suspect the presence of potato " sickness " are asked to communicate with the County staffs or with the Advisory Entomologist at this College.

WOOLLY APHIS PARASITE.

Weather conditions during the early part of the year were very unfavourable to the colony of the Woolly Aphis parasite, *Aphelinus mali*, near Barnstaple. As a consequence the Woolly Aphis increased considerably up to the end of June. Warm weather in July and August, however, helped the parasite and by the beginning of September the Woolly Aphids were heavily parasitised.

HOT WATER TREATMENT OF STRAWBERRY RUNNERS.

Further experiments have been carried out on the treatment of strawberry runners by immersion in hot water. The experiments have been made at monthly intervals, employing during each month a variety of temperatures and times of immersion. Observations have been made on the effects of the treatments on the mite, *Tarsonemus fragariae*, Strawberry Aphis, *Capitophorus fragariae*, and the Strawberry Eelworm, *Aphelencoides fragariae*. While no definite recommendations can yet be made, the work has reached the stage when it may profitably be discussed with growers who are interested.

HOT WATER TREATMENT OF NARCISSUS BULBS.

A thorough investigation by the Entomologist into the technique of the hot water treatment of bulbs is in progress. A number of important points relative to the heating of the bulbs themselves and the effect on the bulbs and on eelworm, have been investigated. It is likely that results of practical importance to growers will arise from this work.

The Mycologist has carried out experiments and collected observations on the relation of the date of the treatment to leaf and flower damage and to the incidence of fungal diseases in many different varieties.

STRIPE DISEASE OF NARCISSI.

"Yellow Stripe" has increased seriously during the last year, particularly in certain valuable varieties such as King Alfred. Little is known as to how the trouble is spread in the field, and experiments and observations are therefore being carried out to see if stripe can be transferred by insects or mites or any artificial methods.

PRESENCE OF NARCISSUS FLY AND EELWORM IN IRIS.

It is recorded on page 16 that a larva of the Greater Narcissus Fly, *Merodon equestris*, was found in a sample of Dutch Iris Bulbs imported from Holland.

The Bulb Eelworm, *Anguillulina dipsaci*, has been also found in Dutch Iris, by Mr. W. E. H. Hodson, now of Reading University.

Neither of these pests has yet been found in Iris growing in Devon or Cornwall, but growers are advised to bear such a possibility in mind. With increased control measures against Narcissus Flies it is to be expected that this pest may turn its attention more to Iris. Any Iris suspected as being affected should be sent to this department of the College for immediate examination.

PUBLICATIONS.

By L. N. STANILAND.

Articles on "The Principal Causes of Failure in Strawberries," "Slugs and Snails," and "A New Pest of Violets" in the Seale-Hayne College Monthly Bulletin.

By A. BEAUMONT.

Articles on "Apple Scab" and "Chrysanthemum Rust" in the College Monthly Bulletin.

"The Relation of Weather to the Appearance and Progress of Potato Blight." (Report of the Agricultural Meteorological Conference, 1931, pp. 12-17).

Notes on Unusual Eelworm Attacks on Narcissus (Var. Soleil d'Or.)

Four cases of a curious attack by the Bulb Eelworm, *Anguillulina* (*Tylenchus*) *dipsaci**, have been examined; three cases were in Cornwall, in two of which the bulbs were from the same source, the fourth instance being in East Devon. At each centre the bulbs were being forced and considerable losses of flowers took place.

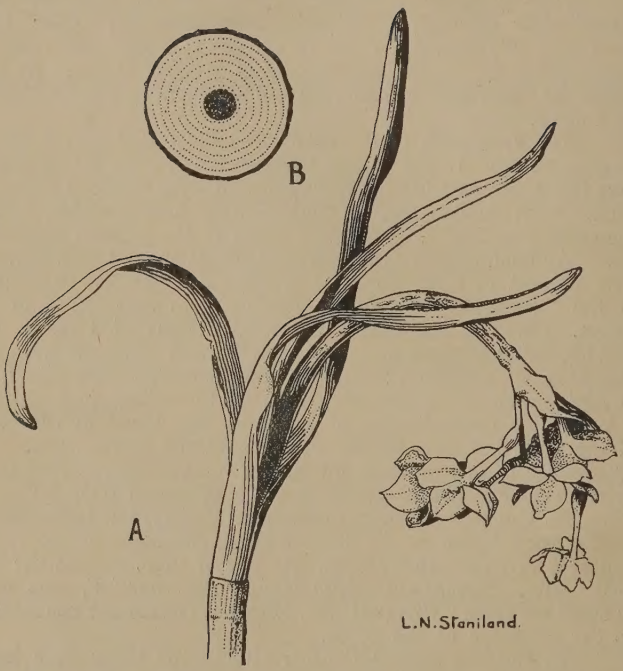
The symptoms of the attack are illustrated in the accompanying sketch. It will be seen that the flower stem is so deformed that the upper part is bent downwards like the crook of a walking stick. Such flowers are, of course, quite unmarketable, and in the cases examined caused severe losses to the growers concerned.

An examination of the affected plants showed that eelworms were present in large numbers in the flower stems, particularly in the "crooked" portion. Eelworms were also found in the leaves. Later in the season the flower stems died down very rapidly, being reduced to a rotting mass, and eelworms were then exceptionally numerous; non-parasitic eelworms were also found in large numbers. Later still, when all the foliage had withered, a very large concentration of eelworms was found in the centre of the bulb, but only in the area around the flower stem. The appearance of one of these bulbs, cut transversely, is also shown in the sketch. Where the same stock of Soleil d'Or bulbs was forced by two growers, bulbs of the same variety, but from different stocks, were forced in the same houses; no signs of the trouble appeared in these other stocks. At one of these centres the Bulb Scale Mite, *Tarsonemus approximatus, var. narcissi*, was found in small numbers; this pest was, however, clearly not contributing to the condition of the bulbs.

In the two related Cornish attacks the bulbs were known to be slightly affected with eelworm when bought, but only a very small percentage showed typical rings indicating the presence of eelworm and in no case was the amount of ringing at all severe.

At present, the source of the eelworm must necessarily be somewhat of a speculation. The nature of the attack, however, strongly suggests a mass attack by eelworm from the soil (in which the bulbs were boxed) direct into the flower stem and the leaves. This view is supported by the fact that eelworm was difficult to find near the base of the flower stems, but was very plentiful in that portion of the stems which was deformed.

* It will be noted that the generic name of this pest has recently been changed from *Tylenchus* to *Anguillulina*.



A. Deformation of flower stem of narcissus (var. Soleil d'Or) by eelworm.
B. Bulbs in transverse section, showing concentration of eelworm in centre.

The eelworm could easily be accounted for by boxing of the bulbs in infected soil. In the case of the two related cases, the growers seemed confident that this could not have occurred. No definite information in this respect was received from the other growers. Alternatively, the very small percentage of the bulbs infected with eelworm when boxed may have acted as centres from which the spread took place. The number of affected bulbs was, however, so small that it is difficult to believe that each box received several infected bulbs, whereas all boxes showed the symptoms described.

It is hoped that further observations may be made which will throw light on these questions. If any growers experience similar trouble the Advisory Entomologist would be interested to receive particulars of the attack and especially the history of the bulbs, source of soil used for boxing and method of growing.

Notes on a New Aphid Pest of Violets

Myzus ornatus. sp. n.

During January, 1932, a visit was made at the request of two growers in the Dawlish district in connection with an aphis which was causing considerable damage to violets. The injury to the plants took the form of severe stunting of the plants, curling and distortion of the leaves, and spotting of the petals of the flowers.

Since the aphis did not appear to coincide with the descriptions of any aphids in Theobald's " British Aphides," specimens were sent to Mr. F. Laing at the British Museum of Natural History. Mr. Laing found that the aphid was a new species of the genus *Myzus* and assigned to it the specific name *ornatus*. The full description of the apterous viviparous female and the winged viviparous female will be found elsewhere.*

* Laing, F.—" A New Aphid Pest of Violets "—The Entomologists Monthly Magazine, Vol. lxviii, March, 1932.

Briefly, the wingless aphid is green with a number of dark brown spots on the body. In the winged aphid the head and thorax are dark blackish-brown, the body being green with the usual brown spotting; the veins of the wings are dark brown.

The pest has now been under frequent observation for a little over a year. Whether the behaviour of the pest as observed during this period has been normal or not cannot yet be decided. The life cycle and habits so far as known are as follows:—

During 1931 the trouble first caused concern to the growers about the middle of December. There is a probability that the aphis has been present for at least three years previous, and the growers agreed that the spotting of the flowers usually started soon after the commencement of the flowering period.

The attacked plants were markedly yellower in colour than those which were healthy, some leaves on the former having decided yellow areas. As a rule, attacked plants bore a somewhat excessive number of weak lateral crowns as compared with the healthy plants, and greatly resembled "small leaf" in strawberries as produced by the aphis, *Capitophorus fragariae*.

During January, 1932, the aphids were all wingless viviparous females and were present in large numbers on leaves, among the crowns and on the runners. Some plants were practically killed. By the beginning of February the plants were, on the whole, much greener; they were putting forth fresh leaves and the aphids were not so numerous. A fair proportion of the aphids were showing signs of becoming winged, which took place a week later (February 8th). Quite a number of aphids were found to be parasitised. During the first week in March the foliage was just commencing to shoot after its almost complete destruction by cold winds, snow and frosts during the latter half of February. Despite the weather conditions, and the destruction of nearly all the foliage, aphids were present on the plants in small numbers.

Whether a complete migration of the aphids from the violets took place in February, or not, is not known. The aphids gradually increased in numbers throughout April, May and June until, during the latter month especially, plants were being seriously affected once more. Winged forms were first seen on June 3rd and towards the end of July they were being produced in large numbers and were obviously leaving the violet plants. By the middle of August practically no aphids could be found. No alternative host plant has yet been discovered. Early in September aphids were found to be present in small numbers and a gradual increase took place. By the middle of November the number of aphids was still not nearly as great as had been found during the early summer, but cold east winds led to the invasion of the

flowers by the aphids, and the commencement of the most serious source of loss. The aphids were found to enter the flowers as soon as the petals had opened sufficiently to allow the insects to enter. White patches are caused which often turn a greenish colour. The damage has, during the last two flower seasons, commenced immediately after the first cold period in the flowering season. The severity of such winds may influence the extent to which the sucking of the aphids produces the spotting of the petals. Damage to the flowers continued through November, December and January (1933), though the majority of the aphids were still to be found in the flowers. Exceptionally cold weather was experienced in January and early February, the leaves of the plants largely being destroyed. Aphids, however, remained on the plants in small numbers still mostly in the flowers. With the advent of warmer weather the aphids increased and commenced to attack the leaves again, particularly the newly forming leaves, and "small leaf" types of plants were again produced. Two year old plants seem to suffer in this respect more than the younger plants. Flower damage was now at its worst; it would seem that the amount of damage depends greatly on the rate of opening of the flowers since, when the flowers open rapidly, the aphids have insufficient time to produce serious markings in the petals.

This aphid pest has been found to be widespread in the Dawlish area, present at several centres in East Devon and also in West Cornwall in a few places.

CONTROL MEASURES.

While it has not been possible to devise certain means for the control of the pest during the short time which it has been under observation, certain important points are realised.

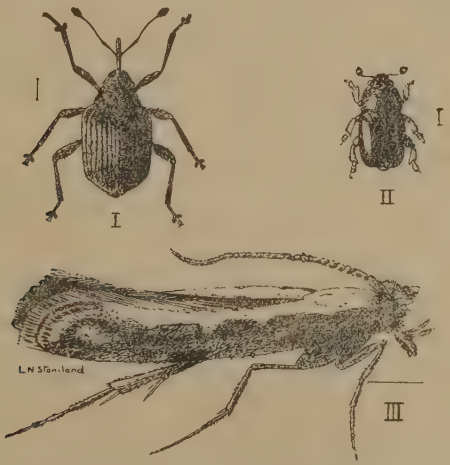
1. That runners may satisfactorily be freed from aphis prior to planting, by dipping in an insecticide.
2. That aphis can be controlled to a fair extent by means of spraying and "stripping" of the leaves during late spring and early summer.
3. That measures 1 and 2 may be beneficial, and even necessary, to the condition of plants and the avoidance of the "small leaf" condition, but that the critical time for treatment is probably towards the end of August and the beginning of September. In the case of light attacks, prior to the summer migration, control measures may not be necessary. But a comparatively small number of aphids after they have returned to the violets may cause serious injury to flowers, since cold weather leads to their concentration within them. Once aphids can gain the shelter of the flowers, control measures would seem to be impossible.

Experiments in the dipping of runners in an insecticide containing pyrethrum and used at 1 per cent. strength have been carried out. The tops only were dipped and they were plunged with an up and down motion, thus driving the insecticide well into the young folded leaves. The plants were shaken and planted at once. This method has been found to kill all aphids if carried out with care. Dipped and undipped runners were planted and little difference could be detected in their subsequent behaviour. The amount of flowers produced by the two plots was about equal.

Subsequent attacks may be dealt with by spraying with a nicotine and soft soap solution (6 ozs. of 98 per cent. nicotine to 100 gallons of water, with sufficient soap to cause a lather to form). Dusting with a dust containing nicotine may be used as an alternative, but only under really suitable weather conditions. It is clear that for spraying or dusting to be effective, a certain amount of leaf stripped is desirable. Plants much stunted and curled should be stripped completely. Plants infested with aphids, but little affected by them, need only have the lower leaves stripped. Two treatments at an interval of a week are required, in order to allow the last formed leaves, not unfurled during the first spraying, to open fully and expose the aphids feeding within. Spraying should be carried out in late spring or early summer and again just prior to the commencement of the flowering period, which period would appear to be by far the most important.

Seed Pests of Broccoli.

Consequent on the increased interest now being taken in the growing of broccoli in the South Western Counties, more attention is now being given to the production of broccoli seed. Observations in both Devon and Cornwall have shown that one important factor as regards yield of seed is undoubtedly that of insect pests. Some five species of insects are important in this connection, and a short account of these is given so that growers of broccoli may guard against attacks. It is hoped that the opportunity will occur for these pests to be studied in greater detail, particularly with regard to their control. Broccoli growers who experience trouble with any of these pests would greatly assist by writing to the Advisory Entomologist, Seale-Hayne Agricultural College.



I. Turnip Seed Weevil (*Ceuthorrhynchus assimilis*).
II. Blossom Beetle (*Melegethes aeneus*).
III. Diamond Back Moth (*Plutella maculipennis*).

THE TURNIP SEED WEEVIL, *Ceuthorrhynchus assimilis.*

The small weevil (Fig. I.) bears a close resemblance to the Turnip Gall Weevil, but it is lighter in colour, being of a leaden grey. The weevil is about 1/8-inch in length.

The weevil appears in the spring and deposits eggs in the seed pods of the broccoli. Eggs may also be laid, before the seed has set, in the seed vessels. The curved, legless, white grubs feed on the pistils of the flowers and on the unripe seeds. Badly attacked seed pods usually open earlier than they should, the fully fed grubs falling to the ground where they change to pupae, or chrysalides, some two inches below the ground in earthen cells. It is probable that there are two generations during the year.

Charlock and other wild species of *Cruciferae* are also attacked, and every endeavour should be made to keep such weeds in check, since their presence is highly favourable to severe attacks on broccoli. The pest may be found attacking most cultivated cruciferous plants.

No definitely successful control measures are known, but spraying with washes containing derris or pyrethrum, such as are employed in the control of the Raspberry Beetle, would be likely to succeed. Such sprays are used on raspberries while the flowers are open without causing damage, a point clearly of importance where seeding broccoli is concerned.

THE BLOSSOM BEETLE, *Melegethes aeneus.*

In small numbers, this insect (Fig. II.) probably does more good, by pollinating the flowers of broccoli, than harm. But it is often, unfortunately, present in such numbers that serious loss of seed takes place.

The pest spends the winter in the beetle stage and these beetles come out in the spring and lay eggs in the flowers of broccoli and other cruciferous plants, both cultivated and weeds. The grubs, or larvae, live within the buds and flowers and feed on the pollen. The total length of the life history is from 35 to 40 days. The larvae, when fully fed, pupate in the soil. The beetles themselves frequently damage many buds in the spring, in their search for pollen, before the flowers have opened.

Dusting with lead arsenate is said to be effective. The methods of control discussed in connection with the Turnip Seed Weevil would probably answer in the case of this pest.

THE DIAMOND BACK MOTH, *Plutella maculipennis.*

This moth is quite small, having a wing expanse of only 5/8th inch. The moth takes its name from the creamy triangular shaped marking on the hinder edge of the forewings (see Fig. III). These markings, meeting those on the other forewing when the

moth is at rest, give the effect of diamond-shaped areas on the back. The ground colour of the forewings is light brown ; the hind wings are grey and heavily fringed with hair-like scales.

Hibernation takes place in the pupal stage in a cocoon on the plant or in adjoining rubbish. The moths may be found in May and June when they lay eggs on cruciferous plants both cultivated and weeds. The small caterpillars at first tunnel under the surface of the leaves, but later feed in the ordinary manner common to most other caterpillars. The caterpillars when fully fed are ½inch long, light green in colour with a yellowish brown head. The body tapers towards both ends. Besides the damage caused to the leaves, the caterpillars feed upon the developing seed pods and can cause very serious losses. Two generations are produced in each year, and the pest is found to be especially abundant in coastal districts. Warm dry weather is definitely favourable to the pest.

The caterpillars may easily be controlled on plants kept for seed by means of spraying with a wash containing lead arsenate. Cruciferous weeds must be kept down as much as possible.

OTHER CATERPILLARS.

The caterpillars of the White Butterflies cause injuries to seeding broccoli. Two species of White Butterfly are found, viz.: The Large White, *Pieris brassicae*, and the Small White, *P. rapae*. These pests attack most Crucifers. On seeding broccoli, lead arsenate sprays may be employed as for the Diamond Back Moth.

Notes on Pests during the Year.

CEREALS.

Cereal pests, with the exception of slugs, have not been abundant. A severe attack of the beetle *Lema melanopa* occurred on late barley in North Cornwall, but heavy winds gave a natural control. A fly, *Phorbia genetalis*, occurred on wheat in East Devon, but no recurrence took place ; a joint examination of the case, between the Adviser and the Advisory Chemist, showed that soil conditions were the primary cause of the condition of the crop.

PULSE.

Beans have not suffered severely from Black Aphis, *Aphis rumicis*. Runner beans were attacked by Springtails, *Isotoma sp.*, and by Millipedes, *Blanjulus sp.*, in South Devon. An unusual pest on French Beans was a severe attack by the larvae of the Bean Root Fly, *Chortophila fusciceps*, involving the complete ruin of an acre of the crop near Truro.

ROOT CROPS.

Apart from Potato Sickness, with which is associated the eelworm, *Heterodera Schachtii*, potatoes were free of serious pests. Potato sickness is, however, spreading in Devon and Cornwall, and is reaching serious proportions ; in particular, the early potato growing areas at Perranuthnoe, Marazion and Gulval are affected. Potato sickness also occurs in East, South and North Devon at a number of centres. It is essential, if this spread is to be checked, that any suspected crop be examined.

Mangold Fly, *Pegomyia betae*, was found in only a few instances in Devon, and the attacks were too late to cause losses. Cutworm damage, *Agrotis spp.*, was extensive on mangolds in the Totnes area. Cases of damage by rabbits also occurred in East Devon. Flea Beetle attacks were below normal.

BRASSICAE.

Brassicae suffered heavily, both in Cornwall and Devon, from the attacks of the Cabbage Root Fly, *Chortophila brassicae*. Broccoli, the Early Cornish variety in particular, suffered most severely. An attack of the Cabbage White Fly, *Aleurodes brassicae*, was noted near Torquay. Damage to seeding broccoli by the Turnip and Cabbage Seed Weevil, *Ceuthorrhynchus assimilis*, has markedly declined in Devon and Cornwall as compared with last year. Some severe attacks of Blossom Beetles, *Melegethes aeneus*, and by the Diamond Back Moth, *Plutella maculipennis*, were seen in South Devon, and these pests were equally serious. Cutworms, *Agrotis spp.*, wireworms, *Agriotes spp.*, and Leatherjackets, *Tipula spp.*, caused losses, in various parts of the province, to kale, cabbage, and broccoli. Attacks by the caterpillars of White Butterflies, *Pieris spp.*, on brassicae have been heavy and general.

OTHER VEGETABLES.

On the whole, other vegetables suffered little injury by pests, the more important of these being remarkably scarce. Tomatoes suffered from severe attacks of Leaf Hoppers, *Erythroneura pallidifrons*, in South Devon. The most important feature of the year, so far as this crop is concerned, was the discovery of the Symphylid, *Scutigerella immaculata*, under glass on tomatoes in the same district. The pest is very minute, and is intermediate in its characteristics between the Centipedes and the Millipedes. The damage takes the form of injury to the root hairs of the plants, with consequent severe checking of growth. The infestation was not of great severity, but steps were taken to deal with the attack ;

the treatment appears to have eradicated it, since no further damage occurred. The Greenhouse White Fly, *Trialeurodes vaporariorum*, is still frequently seen, but the majority of growers are now able to deal with this pest. A case has, however, occurred of the pest breeding on elm in the open in the Penzance district, constant re-infection of the house from this outside source rendering its control extremely difficult. Woodlice caused injury to cucumbers in Devon and Cornwall.

FRUIT.

Fruit pests were, on the whole, of normal occurrence. Winter Moths, *Cheimatobia brumata*, etc.,were fairly severe, the only striking point being the marked manner in which the very late flowering varieties, such as the "Pocket Apples," escaped injury to the blossom, as well as the leaves, and consequently bore good crops. Apple Aphids were fairly common, but no cases of severe injury were seen. Woolly Aphis, *Eriosoma lanigera*, was rather more severe than during the previous year. Apply Sawfly, *Hoplocampa testudinea*, was below normal. Apply Capsid Bug, *Plesiocoris rugicollis*, continues to spread and is now to be found in grass orchards, particularly in the Totnes district. The more advanced fruit growers are now, however, achieving greater success in the control of this pest. Defoliation of plums was much hastened where soils were deficient in potash, by attacks of Leaf Hoppers. Aphis attacks on black and red currants were severe in parts of Devon, but aphids were generally common on Gooseberries throughout the province. Gooseberry Sawfly, *Pteronus ribesii*, was severe but of local occurrence ; taking the province as a whole, little damage was caused.

A few cases of Raspberry Beetle, *Byturus tomentosus*, have been noted in South Devon, and this pest would seem to be spreading Strawberries were severely attacked by Strawberry Aphis, *Capitophorus fragariae*, and by Red Spider, *Tetranychus telarius*, in South Devon, particularly in the Dawlish district. Aphis attacks were particularly serious on the variety Leader in the Coombe Martin area, North Devon. "Red plant" and "Cauliflower disease" associated with an eelworm, *Aphelencoides fragariae*, are of general occurrence in all strawberry districts, but of exceptional severity at Weare Gifford, North Devon. The Strawberry Mite, *Tarsonemus fragariae*, has caused injury to strawberries on a number of occasions, but has been more local in its distribution during the year than aphis or red spider. Leatherjackets, *Tipula spp.*, destroyed young plants at several centres in South Devon, and slight damage to fruits by Ground Beetles, *Ophonus pubescens*, was also noted.

FLOWERS.

Wallflowers suffered severely in Devon, and especially in West Cornwall, from attacks by Cabbage Root Fly, *Chortophila brassicae*. Losses to several commercial growers of this crop were severe, and, in the majority of cases, a trouble not previously experienced.

Considerable injury by slugs to hyacinths and tulips were noticeable in the early part of the year.

Bulb eelworm, *Anguillulina* (*Tylenchus*) *dipsaci*, continues to be widespread, and few growers are known whose stocks of bulbs are apparently free from infection. This eelworm was found in hyacinths in East Devon and in wild bluebells in South Devon.

The recently discovered Bulb Scale Mite, *Tarsonemus approximatus*, *var. narcissi*., has been found at various centres in the province, both in the open and under glass. Damage by Narcissus flies, *Merodon* and *Eumerus*, has been of about normal intensity.

A larva of the Greater Narcissus Fly, *Merodon equestris*, was found in a sample of Dutch Iris bulbs, this being an unusual host plant. Damage to iris by rabbits occurred in West Cornwall. The flowers of Anemones in West Cornwall were mutilated by larks, locally known as "Grey Birds."

Violets in the Dawlish district suffered severely from attacks of Red Spider, *Tetranychus telarius*, particularly on the small holdings where the ground is cropped more or less continuously with violets. The outstanding pest of the year on violets was a new aphis, *Myzus ornatus*, hitherto undescribed, and of unknown origin, which was the cause of serious losses in the number of flowers marketed. An account of this pest will be found elsewhere in this report. The larvae of a fly, *Psila nigricornis*, were responsible for considerable losses of cuttings on chrysanthemum stools in South Devon.

BEES.

Acarine Disease of Bees, *Acaraphis woodi*, has declined considerably by comparison with the prevalence of the disease during the previous year.

Pests Reported from Devon & Cornwall.

This list comprises those insects not reported in the eight previous years and those occurring on host plants previously unrecorded.

Pest.	Crop.	Remarks.
	CEREALS.	
Diptera		
Phorbia genetalis (Schnabl)	Wheat.	Larvae tunnelling in the shoots of wheat at Broadclyst, E. Devon.
	PULSE.	
Collembola		
Isotoma sp.	Runner Beans.	Severe damage to roots of young seedlings, Newton Abbot, Devon.
Diptera		
Chortophila fusciceps (Zett.)	French Beans.	An acre completely ruined near Truro.
	BRASSICAE.	
Coleoptera		
Melegethes aeneus (F.)	Seeding Broccoli.	Severe damage to flowers at Newton Abbot, with consequent lowering in yield of seed.
Lepidoptera		
Plutella maculipennis (Curt.)	Seeding Broccoli.	Caterpillars devouring ripening seeds pods at Newton Abbot.
	FRUIT.	
Coleoptera		
Ophonus pubescens	Strawberry.	Damaging ripe fruits near Lustleigh, Devon.
	FLOWERS.	
Rhynchota		
Myzus ornatus (Laing).	Violets.	A new species of aphid causing great losses in Dawlish district by damage to violets. Plants stunted and petals of flowers spotted. Also found at Sidmouth and Topsham in Devon and in West Cornwall.

Diptera		
Chortophila brassicae (Bche.)	Wallflower.	Considerable losses in West Cornwall.
Merodon equestris (F.)	Iris.	Larva of this fly found in a sample of Dutch Iris from Holland.
Psila nigricornis (L.)	Chrysanthemum.	Larvae killing cuttings on chrysanthemum stools at Newton Abbot. Pest has been controlled by means of naphthalene as for carrot fly.
Acarina		
Tarsonemus approximatus (Banks) var. *narcissi* (Ewing)	Narcissus.	The recently discovered pest (The Bulb Scale Mite) has been found in Devon and Cornwall at various centres in the open and under glass. Polyanthus varieties, Golden Spur and Sir Watkin, are those most frequently seen to be attacked.
Birds		
Larks	Anemone.	Mutilating or removing the petals from anemones in West Conrwall.
Rodents		
Rabbits.	Iris.	Iris eaten off, practically to ground level. West Cornwall.

MISCELLANEOUS.

Woodlice		
Oniscus sp. (Ml.)	Cucumber.	Eating away irregular areas in the skin of cucumbers in Devon and Cornwall. The patches turn white in colour.
Symphylidae		
Scutigerella immaculata (Newp.)	Tomato.	Causing severe stunting of plants under glass in South Devon.

Notes on Fungal Diseases during the Year.

One of the most critical months of the year from the point of view of fungal diseases is the month of May. Wet weather in May particularly encourages the principal fungal diseases of fruit trees. The rainfall in May, 1932, was greater than in any year since 1924, and with this may be correlated the very heavy attack of Apple Scab and the first appearance in significant amount since 1924 of Apple Blossom Wilt. On the other hand, the rainfall of July and August was below normal, and the diseases of farm crops were generally slight. Potato Blight was rather early in appearing and its spread was favoured by humid weather in August, but the attack on the tubers was less severe and a normal crop was obtained.

The rainfall figures at Seale-Hayne College are as follows:

February	.....	0.05 in.	June	.....	3.58 in.
March	.....	2.57	July	.....	1.71
April	.....	2.50	August	.....	1.79
May	.....	4.09	September	.....	5.15

CEREAL DISEASES.

Rusts did no damage and Smuts were not above normal. Cold weather early in the year checked growth and Leaf Spot of Oats (*Helminthosporium Avenae*) was unusually troublesome. In some cases it was so bad that the fields had to be re-sown, but generally recovery took place with warmer weather. Soil analyses showed the attacked fields to be low in potash and in nitrates; the former can be corrected, but the nitrate supply is kept down by cold weather. It is probably only in these adverse conditions that the Leaf Spot can do damage. These conditions are, however, so common that it is worth while to take the precaution of dusting the seed with one of the new mercuric dusts before sowing. Many farmers did this and were very pleased with the results, germination and early growth being very satisfactory. Glume Blotch (*Septoria nodorum*) was observed for the first time on wheat, and Leaf Spot (*Septoria Tritici*) was not uncommon.

POTATO DISEASES.

Blight appeared in West Cornwall on May 30th, a little later than usual. It had been observed in volunteers in narcissus and broccoli crops in mild weather in the previous December and January, but, of course, did not spread. Even at Seale-Hayne College in a sheltered corner near the greenhouse, where there was a waste heap containing diseased tubers, diseased sprouts were collected on December 12, 1931, and developed spores in a few days in a moist jar and many of the spores were successfully germinated. This observation shows the danger of throwing away diseased tubers instead of destroying them.

Among maincrop varieties Blight was later than last year, but appeared about the same time in all districts (July 15 to 18). The only record in Devon earlier than this was in one locality in North Devon on June 28th. The disease became generally severe in Cornwall at the end of July and in Devon in August. Crops lifted were generally good and not much affected by disease. Not much additional spraying was carried out, growers being undoubtedly discouraged from going to this extra trouble by the low prices prevailing.

Other potato diseases were less common than usual except "potato sickness" (p. 3) which is increasing in both Devon and Cornwall. In most cases the fungus, *Rhizoctonia*, was not found.

DISEASES OF ROOT CROPS.

Black Leg of Mangolds was remarkably scarce, and liming trials gave therefore no information about the control of the disease, although a beneficial effect was noticed on the growth of the crop. Rust and Heart Rot were not observed. Excellent crops were harvested in most districts. Some roots were found to be blackened at the base; from what cause could not be ascertained. There were no fungi present and the keeping quality of the root does not appear to have been affected.

Finger-and-Toe was prevalent on swedes and turnips, but not above normal. A special article is published in this Report. Soft Rot (*Bacillus carotovorus*) was more frequent than usual in August, as much as 10% of the plants being affected in some fields. The infected plants recovered to a large extent later in the season. The leaf spot caused by *Alternaria Brassicae*, though common, rarely does significant damage. It was serious in one field, but analysis of the soil showed it to be very poor, and this may account for the reduced crop. Turnip White Spot (*Cercospora Bloxami*) was present everywhere, but did no damage.

CHOCOLATE SPOT OF BEANS.

There were several cases of heavy loss, though the disease did not appear on such an epidemic scale as last year. It was found then that the soils where the disease occurred were deficient in potash, either in the actual amount of available potash or in the amount relative to the available phosphates. Soil samples were again collected this season and analysed by the Advisory Chemist. Most of the cases showed potash deficiency, but there were two exceptions described below. Chocolate Spot is a bacterial disease, and the effect of potash shortage will therefore be an indirect one, that is to say, the growth of the plant is affected making it more easily attacked by the disease. It would appear probable that any other factor prejudicial to the growth of the plant might encourage Chocolate Spot. Lime shortage for example might be as important as potash shortage, especially as it is a well-known fact that leguminous crops require lime. In the following table the lime figure (numbers below 6.6 are short of lime), phosphates and potash are given for each soil sample.

Sample No.	pH.	Phosphates.	Potash.
1932	7.33	.024	.010
1933	6.57	.024	.011
2205	5.67	.081	.011
2328	5.33	.146	.020
2329	4.44	.010	.022
2139	6.41	.021	.029
1958	7.89	.033	.015
1970	8.17	.038	.051
Standard	7	.03	.03

Samples 1932 and 1933 were from half an acre of Broad Beans near Stoke Canon, which were badly attacked in May, but recovered considerably in June, the new growth coming clean. Comparison with the standard figures at the bottom of the table shows that the soil was not short of lime, but was very deficient in potash. Sample 2205 was from a market garden near Plymouth and shows not only potash deficiency but an excess of phosphates ; which has the effect of making the potash still smaller in proportion. Samples 2328 and 2329 were from two plots near Yelverton, the first from a plot which was free from Chocolate Spot and the second from newly broken ground in which the beans were badly attacked. The potash rule does not apply here ; the explanation probably lies in the low fertility of the soil as indicated by the low figures, and in the remarkable shortage of lime indicated

by the very low figure 4.44. Sample 2139 is another anomalous case obtained from near Lyme Regis, where Field Beans were attacked. The analysis shows quite a normal soil not deficient in any particular. It was suggested that the soil was on the light side for beans, but unfortunately a personal inspection of the field could not be carried out. It is not possible to give a satisfactory explanation of this case. Samples 1958 and 1970 are from diseased and healthy beds respectively at Newton Abbot. Both beds had plenty of lime, but while the healthy bed was well supplied with potash, the diseased bed was deficient. This example shows the importance of potash very clearly. A final example in which no soil sample was collected is, also, evidently due to potash deficiency. Field beans were attacked near Kingsbridge, and it was noticed that there was a healthy patch where hedge rubbish had been burned, thus supplying a large dressing of potash.

DISEASES OF PASTURES AND LAWNS.

The profuse development of grass rusts in September of 1931 was not repeated in the autumn of 1932. No clover diseases were observed.

A bowling green in East Devon showed brown patches early in the spring and these were found to be caused by the snow mould (*Fusarium nivale*).

Two cases occurred at Brixham of an annoying development on tennis lawns of gelatinous masses of blue-green algae. Watering with a $2\frac{1}{2}\%$ solution of copper sulphate was recommended and was found to be successful.

DISEASES OF VEGETABLES.

Tomato troubles were less severe than usual, though all occurred to a moderate extent. Leaf Mould (*Cladosporium fulvum*) was first observed in Penzance on June 10th, but was not above normal. The virus disease, Spotted Wilt, was observed for the first time. It did very serious damage at Penzance, being introduced on plants from Cambridge.

Bacterial leaf spot on lettuce was less common than in the previous year. Losses in greenhouses due to the Grey Mould (*Botrytis cinerea*) were common; they can always be traced to excessive watering or to extreme temperature fluctuations.

Broccoli diseases were less severe than in 1931, though widely distributed. Downy Mildew (*Peronospora parasitica*) was common on seedlings in the summer, but caused little loss. Brussels Sprouts suffered severely from Ring Spot in the autumn, and in a few cases this disease was observed in appreciable amount on Roscoff Broccoli for the first time.

Physiological Damping-off continues to be the most serious trouble of Cucumbers, and generally arises through faulty construction of the houses. A bad case of gummosis (*Cladosporium cucumerinum*) in North Devon was traced to inadequate ventilation. Mildew is usually common on Marrow in private gardens, and a bad case on a commercial crop was observed in August.

FRUIT TREE DISEASES.

American Gooseberry Mildew was again late in appearing. It was first observed on June 2nd, but it made slow progress until after the fruit had been picked. The mildew then developed profusely in unsprayed gardens. The gooseberry crop suffered severely from frost in some parts of Devon.

The most severe fruit disease was undoubtedly Apple Scab, the worst season since 1924 being experienced. Scab lesions were abundant on the young wood of Cox's Orange Pippin in January and February, and some which appeared to be active on March 1st were examined. Numerous immature spores in all stages of formation were found. These twig lesions probably gave rise to most of the initial infections. Perithecia on decayed leaves collected the previous autumn were less abundant than usual. Mature ascospores were found inside them on March 28, but not at later dates. No observation could be made of spores being liberated. Scab on the leaves was exceedingly abundant all summer and caused considerable defoliation of the more susceptible varieties. All the fruit was badly attacked, but the crop was very poor generally. Early sprayings gave good results, and their superiority to dusting was clearly demonstrated. Varieties noted in different places as particularly badly attacked on the leaves and fruit included Sweet Alford, Lord Suffield and Bismarck. Spraying with lime sulphur gave very good results on Worcester Pearmain, but caused injury to Beauty of Bath.

Blossom Wilt on apples was widespread and serious, but not so severely epidemic as in 1924. Apple Mildew was insignificant. Apple Canker was common as usual, but the early spring infections were less severe than in the previous season. Cox's Orange Pippin and Worcester Pearmain are the varieties that suffer most in commercial plantations. In gardens James Grieve, Delicious and Ribston's Pippin are very susceptible. Leaf Scorch was common ; several soils were analysed, and although the potash content was normal it was found that the available phosphates were excessive, so that the soil was unbalanced. Some evidence was also collected that these conditions also favour Canker, and potash manuring and withholding of phosphates are being recommended. Silver Leaf was observed on Newton Wonder. Brown Rot was much less common than usual.

Plum Rust was common, but Wither-tip was very scarce. Brown Rot was common on trees that had never been sprayed. There was a considerable amount on trees of Belle de Louvain which had been sprayed with tar wash in the winter, but at the reduced strength of 5%. Peach Leaf Curl was well controlled by the February spraying with Burgundy mixture, but Lime-sulphur did not give such good results.

Black Currant Leaf Spot was abundant, particularly in September. At Topsham it was very bad on September Black and slight on Boskoop, Blacksmith and Davison's Eight, but these varieties were badly attacked elsewhere. Good results were obtained by spraying with Bordeaux at the end of May, and there was no damage to the crop by the spray.

Raspberry Mosaic is increasing, particularly on Lloyd George. A non-fungal leaf scorch not observed before was serious on both raspberries and loganberries. On the latter it caused wholesale death of the fruiting canes. The cause was provisionally ascribed to the heavy rains of May causing a temporary water-logging effect at a critical time.

Leather Rot of Strawberries did not appear this season to any significant extent, the weather not being favourable. Sudden Wilt was rather frequent locally, but could not be ascribed to any particular fungus. Leaf Spots due to *Mycosphaerella fragariae* and *Marssonina fragariae,* and Mildew were commoner than usual, particularly in September. Mildew was most serious on Royal Sovereign, but Oberschlesien was also attacked. Tardive de Leopold being a late variety escaped. Mildew began on Royal Sovereign at the end of June.

DISEASES OF FLOWERS.

Diseases of flowers were less serious than usual, the early spring being generally dry and cold. Tulip Fire caused very little loss, less than in any previous season. This was undoubtedly due to the dry conditions. Forcing troubles were common in tulips, for example, defective flower-buds which did not develop, due to forcing bulbs of too small a size, and a case of leaf burning and poor rooting traced to the presence of arsenic in the soil and ashes in the boxes.

Iris leaf spot (*Heterosporium gracile*) was not observed, but the Ink disease (*Mystrosporium adustum*) was as common as usual. A failure of the flowers in certain of the more delicate varieties, particularly Wedgwood and Yellow Queen, was put down to the cold weather, the effects of which were probably assisted by the lack of lime in the soil.

Narcissus diseases were all below normal except *Botrytis narcissicola*, which was more widespread than usual but rarely epidemic, and Yellow Stripe, unusually serious on imported bulbs and leading to a very large number of enquiries in the spring. Most of the poeticus varieties escaped the usual flower spotting caused by *Stagonospora Curtisii*. This fungus was found causing leaf scorch damage to the Belladonna lily; this is apparently the first time it has been observed on this host in Great Britain. Fusarium storage rot was very common in the new consignments of bulbs imported in August and September. White mould (*Ramularia Vallisumbrosae*) was first observed at Penzance on February 23, and was already well developed. Its later progress was slow and generally the losses were much below normal. *Botrytis polyblastis* started in the Scilly Isles on April 5th; it was scarce elsewhere. White Root Rot reappeared on an old site at Penzance.

Scorching and withering of anemone leaves were very common in January in Cornwall, beds grown from corms being more susceptible than those from seed. No fungus could be implicated, and the theory was formed that the trouble was due to heavy rains washing the nitrogen out of the soil. With the advent of warm, dry weather the plants recovered. The trouble was first observed in February, 1926, and has become more prevalent each season. Although only serious in the early months of the year it occurs at other times, and the grey mould fungus (*Botrytis cinerea*) frequently appears on it and adds to the damage. Anemone foliage is very delicate and is easily injured by artificial fertiliser dressings and by cold east winds, but the trouble occurs very often without these. It seems probable that a fertile, well-balanced soil is less likely to produce the phenomen than a less favourable soil, and a number of data have been collected in support of this.

Rose Black Spot was again very common. Mildew nearly always developes on Marigolds grown under glass, but should be controlled by spraying with lime-sulphur.

The Dutch Elm disease (*Graphium Ulmi*) was observed near Totnes, and Plane trees in two localities near Totnes were badly attacked by Leaf Scorch (*Gloeosporium nervisequum*).

Potato Blight and the Weather.

1.—THE OUTBREAK OF BLIGHT IN DEVON.

In the three previous Reports the weather preceding the outbreak of Blight in Devon was investigated and it was shown that the rules formulated by Dutch scientists are of considerable value (for spraying purposes) in making an attempt at forecasting an outbreak. These rules laid down the conditions favourable to Blight to be as follows:—

(1). Night temperature below the Dew Point for at least four hours.
(2). Minimum temperature 10°C. (50°F.) or above.
(3). Mean cloudiness next day 0.8 or more.
(4). Rainfall next day at least 0.1 mm. (0.004 in.)

For convenience in making a rapid study of the weather data prepared daily at Seale-Hayne College by the meteorological observer, Mr. H. McClelland, the conditions have been changed to the following nearest equivalent ones.

(1). Dew observed and recorded either at 9 a.m. or at 9 p.m. the previous evening (the hours of observation).
(2). Minimum air temperature 50°F. (read at 9 a.m.)
(3). Sunshine less than 5 hours.
(4). Rainfall at least 0.1 mm. (read at 9 a.m. next day).

The dates on which the above conditions were fulfilled are set out in the following table:—

	Rule	*Dates.*
May	1	2, 3, 5, 6, 7, 10, 15, 17, 21, 24, 27, 31.
	2	12, 13, 16, 19, 20, 21, 22.
	3	1 to 4, 11 to 15, 18 to 21, 23 to 25, 28 to 31.
	4	7 to 15, 17 to 20, 25, 27 to 31.
June	1	2, 3, 6 to 13, 17 to 28.
	2	3, 11 to 14, 16 to 19, 23, 25 to 30.
	3	2 to 4, 8, 11 to 13, 19, 20, 30.
	4	3, 4, 28 to 30.
July	1	9 to 13, 15, 16, 18 to 20, 22.
	2	1 to 17, 20 to 31.
	3	2 to 8, 11, 13, 15, 17, 19 to 22, 24, 28 to 30.
	4	1, 2, 4, 6, 12, 13, 15, 16, 22 to 28, 30, 31.
August	1	4 to 13, 17 to 20, 25 to 29, 31.
	2	1 to 31.
	3	2, 4, 7 to 10, 13 to 15, 21 to 23, 28, 29.
	4	1, 2, 4, 9, 13, 14, 20 to 23, 29.

Any date which occurs in all the four columns under any month is one that fulfils all the conditions, and blight would be expected a week or two after that date. The only ones are June 3, July 13, 15, 16, 22, August 4, 9, 13, 29. The weather following June 3 was dry and warm and quite unfavourable to blight. The disease broke out in all parts of Devon in the period July 15 to 18, and spread a good deal at the end of the month and in August, so that the July and August dates can be considered as very satisfactory and the value of the Dutch rules is once again confirmed.

It was shown in the Seventh and Eighth Annual Reports that another method different from the above can be used to forecast blight and gives a better indication of the probable severity of the epidemic. This consists in measuring the relative humidity daily. The meteorological observer takes three readings, 9 a.m., 3 p.m., and 9 p.m. These have been collated with the continuous records of the self-recording hygrometer situated in a screen in the potato plot not very far from the meteorological station. Now the blight fungus requires humid conditions for its development, spore formation being impossible below 75% humidity. The longer the periods of high humidity and the higher the humidity the more serious the blight epidemic will be. A period of at least two days in which the relative humidity does not fall below 75% is regarded as an indication of blight provided the temperature is not too low. The dates of high humidity in 1932 were

May 3, 11 to 13, 18 to 20, 31.
June 3, 4, 30.
July 7, 13, 24, 28, 29.
August 10, 14, 15, 21, 22, 28, 29.

The only two-day periods are in May, June 3 and 4, July 28 and 29, and August 21 and 22 and 28 and 29. May can be excluded, as blight has never been observed in Devon in May except in occasional isolated and sheltered localities. Furthermore, there is no doubt the weather is cumulative in its effect on blight, rising temperatures and successive periods of high humidity become progressively more favourable to blight, so that the probabilities of its occurrence after a high humidity period are much greater as the season advances. The results from the humidity observations are then similar to those from the Dutch rules, but are inferior in one important respect, they omit the critical dates in July (13 to 16), which actually heralded the outbreak of blight. An examination of the humidity record explains the discrepancy. On the 13th the humidity was over 80% all day, on the 14th it was over 80% except for a few hours in the

afternoon, when there were fluctuations between 68% and 76%, and next day the humidity was about 90%, except for a short period at mid-day, when it dropped to 65%. For all except two short intervals then the humidity was high during this three-day period. If the humidity records are re-examined and short periods of somewhat low humidity disallowed, we get the following dates in the three summer months :—

June 3, 4, 12, 30.
July 3, 4, 7, 13, 14, 15, 16, 24, 28, 29.
August 4, 10, 14, 15, 21, 22, 28, 29.

These dates give a much more satisfactory indication of the progress of the epidemic, and the important critical period (July 13 to 16), that initiated the outbreak is clearly indicated. The method is not entirely satisfactory, however, inasmuch as personal judgment must enter into the assessment of the high humidity periods. A simple arbitrary rule is desirable, and it is suggested that only the 3 p.m. humidity reading is taken and days in which the humidity is 75 % or over are to be regarded as favourable days. This is also easy to observe, a wet and dry bulb hygrometer being sufficient. It generally happens that a high humidity at 3 p.m. means high humidity all day. In 1932 the favourable dates were the following :—

May 2, 3, 7, 11, 12, 13, 15, 18, 19, 20, 22, 24, 25, 28, 29, 31.
June 3, 4, 6, 12, 19, 30.
July 1, 3, 7, 13, 15, 16, 20, 22, 24, 28, 29.
August 4, 7, 10, 11, 12, 13, 14, 15, 21, 22, 28, 29.

Taking the two-day periods it will be seen that the results do not differ much from the continuous humidity records. Each season this method has given good results. For example, two-day high humidities occurred round about the following dates in 1929, July 1, 28, August 3, 9, 22-31. Blight broke out on July 11 but made little progress in warm, dry weather, and the general outbreaks were in the second week in August. In 1930 critical dates were June 10, 20, July 2, 20, 23, 27, August 2, 8, 17 to 29. Blight did not appear till the beginning of August, so that July 20-27 was the critical period. The Dutch rules in this season also indicated the early dates, and as might be expected, therefore, indications in the first half of the season are less reliable than in the second half. In 1931 blight broke out early and favourable dates were June 4 to 12, 17, July 3, 9 to 15, August 4, 7, 19, 23, 27 to 31. The long period at the beginning of June was a strong indication of blight and the disease appeared at the end of that period.

The simple humidity rule is then very valuable for forecasting Potato Blight in Devon. Can it be applied to other districts? By the courtesy of Mr. H. Bryan, Director of the Potato Testing Station at Ormskirk, Lancashire, it was possible to examine the afternoon humidity readings at this station from May to September.

2.—THE OUTBREAK OF BLIGHT IN LANCASHIRE.

Dates with humidity reading 75% or over are as follows :—

May 2, 5, 6, 9, 11 to 13, 15, 16, 18, 19, 20, 21, 22, 23, 27, 28.
June 11, 28, 30.
July 9, 13, 14, 16, 17, 19, 20, 26, 30.
August 2, 5, 6, 7, 9, 10, 13, 14, 17, 19, 20, 21, 27, 28.

If these dates are compared with the Devon records it will be seen that they indicate blight almost as frequently. The disease did not appear at Ormskirk till August 12 and was never severe, but it appeared in other parts of Lancashire on July 12 and 23. The critical dates, July 14 and 17, are then justified, but for some reason, possibly connected with other factors such as temperature, the disease is less severe in Lancashire than in Devon after any critical date. Weather records are not available to test this. Evidently other weather factors must be borne in mind if humidity data are to be applied to forecasting blight in different parts of England.

3.—THE OUTBREAK OF BLIGHT IN WEST CORNWALL.

It is well known that Blight generally appears in West Cornwall quite early in the spring before it has begun in other parts of the country. The slightly higher temperature and humidity in the spring months probably account for this, and it is therefore of great interest to see whether the humidity rule can be applied to this area. In 1932 in the spring months the relative humidity at 3 p.m. was 75% or over on the following dates :—

April 4, 6, 9, 15, 16, 17, 26 to 30.
May 1, 3, 7, 8, 11 to 15, 17 to 22, 26, 29 to 31.
June 3, 4, 10, 11, 12, 16, 19, 29, 30.

A comparison with the Devon figures already given shows that days of high humidity are more frequent in West Cornwall. The days of minimum air temperature 50°F. or above are also rather more frequent and are as follows :—

May 12, 13, 14, 16, 18 to 22, 31.
June 1, 3, 4, 11 to 18, 21 to 30.

Combining the two sets of data we get favourable blight days on May 14, 19 to 22, June 4, 12, 30. The period May 19 to 22 would appear to be specially favourable, the daily readings being very high, 99%, 81%, 81% and 83% respectively. Blight would therefore be expected at the end of the month and did actually break out on May 30.

The data for 1931 will now be examined to see if the method can be applied equally successfully.

Relative Humidity 75% or over
April 1, 2, 7, 8, 9, 11, 12, 23 to 29.
May 5, 6, 7, 9 to 16, 21 to 31.
June 2, 3, 5 to 16, 18, 19, 21.

Minimum temperature 50°F. or over
May 11 to 15, 23 to 26, 28 to 31.
June 1, 3 to 18, 20 to 25, 28 to 30.

Critical dates in 1931 then were May 11 to 15, 28 to 31, and June 5 to 16. A local outbreak was observed at Gulval on May 9 but the plants were destroyed. The general epidemic began on May 20, i.e., following the first critical date.

The humidity method can then be used very successfully for forecasting blight in both Devon and Cornwall. It was observed, however, that in Devon the early critical dates are less reliable than the later ones. For example, a two-day humidity period with adequate minimum temperature occurred in Devon in 1932 on May 12, 13 and 19, 20, neither of which was followed by blight. Similar discrepancies occurred in 1930 as already shown. On the other hand, in West Cornwall the outbreak follows the first critical date, and may indeed follow periods of high humidity, even when the air minimum does not quite reach 50°. This occurred in the spring of 1930 and also in 1925 and 1927, as pointed out by S. P. Wiltshire (Quarterly Journal of the Royal Meteorological Society, LVII., 1931, 304-316). The probable explanation of this phenomenon is to be found in the cumulative effect of periods of high humidity, which compensate for the lower temperatures. Also the temperature 50°F. is purely arbitrary; it must be realised that a slightly lower temperature such as 48° differs only in a slight degree in relation to the blight epidemic. On the other hand, the humidity figure is a much more definitely marked boundary as it marks the line between spore production and absence of spore formation.

The difference in conditions between West Cornwall and Devon is clearly shown in the following table showing the weekly means of relative humidity (3 p.m.) and minimum air temperature at Gulval and Seale-Hayne College in 1932.

Week ending		% Humidity. Gulval.	Seale-Hayne	Temperature °F. Gulval	Seale-Hayne
April	2	76	77	42.9	41.1
	9	70	68	41.3	38.0
	16	69	68	39.9	38.1
	23	70	69	38.9	39.4
	30	82	78	44.6	42.9
May	7	71	65	43.0	40.4
	14	81	73	44.7	43.1
	21	85	81	49.7	48.1
	28	73	75	46.0	45.0
June	4	83	75	49.9	48.6
	11	68	69	46.0	44.1
	18	59	53	53.6	53.0
	25	65	61	51.7	49.6

On the average then the humidity and the minimum air temperature are always slightly higher in West Cornwall. The cumulative effect of this small but critical difference is regarded as explaining the greater readiness with which blight breaks out around Penzance. Exactly similar figures occur in other seasons, so that the difference represents an essentially climatic feature.

The above meteorological data for West Cornwall were obtained through the courtesy of the Director of the Meteorological Office.

4.—THE NATURE OF AN EPIDEMIC.

In the present article the term "outbreak of blight" has not yet been carefully explained. Obviously, if the conditions are suitable in one particular spot such as a kitchen garden or a greenhouse, blight might break out there. The local conditions might be abnormal for the district, and no spread of the disease would occur and no epidemic would be established. A local outbreak requires suitable conditions in one small area only; for an epidemic the weather must be suitable over a considerable area. Local outbreaks are of no practical significance, only forecasts

of epidemic outbreaks are required, and it is from the point of view of these latter that the weather data have been investigated. To some extent it is unsatisfactory to examine the weather data at only one station, as it cannot be certain that it is exactly representative of the district, and some of the errors may be due to this cause.

Several interesting local outbreaks have been observed occurring when no epidemic could possibly arise. Plants growing on a waste heap in a corner at Seale-Hayne College were observed to have brown lesions on December 12, 1931. In a moist dish these brown lesions developed spores in two days. Some of these sent out germ-tubes in a little water in a watch-glass, and after a night's exposure abundant swarm spores were formed. The development of the blight fungus was therefore normal in every way. The weather of the preceding fortnight had been mild for the season, but the minimum air temperatures were below 50°F. Blight was also observed at the same time on volunteers growing amongst daffodil bulbs near Penzance. Material was collected from this district on January 2nd, 1932, and spores were obtained from it. With colder weather later the blight was destroyed before the early crops were planted, so no epidemic could arise.

5.—THE PROGRESS OF BLIGHT IN 1932.

The epidemic of 1932 was much less severe than that of the previous season, and the losses to the crop were much smaller, although generally considerable. Correlated with this the relative humidity in 1932 was not so great on the average as in 1931. The following table shows the number of days of high humidity (i.e., over 75%) in each month in 1931 and 1932 at Seale-Hayne College.

	1931	1932
May	14	8
June	14	3
July	15	5
August	16	7

The next table gives the average afternoon (15 h.) humidity for each month.

	1931	1932
May	74.7%	73.8%
June	76.6	64.0
July	76.4	72.3
August	74.5	71.7

It is of interest that the averages for Ormskirk, Lancs., for 1932 are very little different from those at Newton Abbot, being 75%, 63%, 70.3% and 72.3% respectively.

Finger and Toe.

Finger and toe is exceedingly common in Devon and Cornwall, where it has been familiar for many years. Hardly any district is free from it. It is always present on the acid soils, especially the less fertile ones, but on the very susceptible broccoli and cabbage crops, it occurs even in the rich soils near Penzance, and in gardens and allotments in many parts of Devon. On farm crops there are also signs of the spread of the disease on good soil, from neighbouring districts which are short of lime, and in which the disease is prevalent. The district around Kingsbridge is an example of this.

VARIETAL SUSCEPTIBILITY.

The plants which have been observed affected with the diesase in Devon and Cornwall are Turnip, Swede, Cabbage (including Ox Cabbage), Brussels Sprouts, Broccoli, Cauliflower, and Kohl Rabi and the weed Charlock. We have not observed it on Marrow Stem Kale, but it is reported to occur on this plant in certain districts of South Devon, where finger and toe is very severe. Not all varieties of these plants are equally susceptible, and the search for resistant varieties is very important to the farmer. For example, among turnips the variety, Bruce, is now available, which shows a very high resistance, and is of good feeding quality. In a trial, arranged in 1932 by the Devon County Council at Stoke Fleming, South Devon, rows of Bruce alternated with rows of a Green Globe Turnip. The latter was totally destroyed by the disease, but Bruce gave a very satisfactory crop, and not more than 5% of the roots were even slightly affected. The higher price of Bruce seed is in cases like these amply repaid.

On the same field the Swede varieties Tipperary and Balmoral (seed from Aberdeen) were similarly compared. Every root of Tipperary was diseased, but a high percentage of Balmoral was clean and very few roots could not be used. Tipperary is by no means the most susceptible variety of Swede: in a trial of a number of varieties at South Brent, Devon, in 1928 it showed the smallest proportion of diseased roots and it was almost as good as Eclipse, Magnificent, and Defiance in a trial near Sidmouth in 1925.

Ox Cabbage is not often attacked, but the safest crop for the farmer to grow on infested land is Marrow Stem Kale. This has frequently given good crops alongside diseased swedes.

There are no resistant varieties of brussels sprouts, cabbage or broccoli. The new Roscoff varieties of broccoli all readily take the disease.

CONTROL OF FINGER AND TOE BY LIMING.

It is well known that finger and toe can be cured by liming, but the details of the method are little understood and the high price of lime completely prevents its general use. First of all it must not be assumed that because a soil is not short of lime, finger and toe will not appear. It is true that the chances of its occurring are much less, particularly in farm crops, but cases have been observed. The table on p. 37 records amongst other data the hydrogen on figure of the soil in different cases of finger and toe in Swedes. Figures above 6.9 indicate soils which are not short of lime, below this, the smaller the figure the greater the lime deficiency of the soil. It will be seen that although finger and toe is commonest on the rather acid soils (pH 5.5. to 6.3) it is not absent, even from swedes,in soils that are not short of lime. Finger and toe is even commoner in Broccoli in soils adequately provided with lime, as is shown by the table on p. 38.

Lime may be applied in several forms. Gas lime, waste lime and ground limestone are forms of carbonate of lime and must be distinguished from quicklime, burnt lime, and hydrate of lime, in which the lime is present in a more active form. Trials in different parts of England have shown that carbonate of lime is useless against finger and toe ; *lime must be applied in the active form.* For example, at Poltimore, Devon, in 1929, the farmer was surprised that the disease was severe, although the field had been dressed with one ton of limestone and 5 cwt. basic slag per acre. Quicklime should have been used. Another important point is that the lime must not be left in heaps to break down, but must be harrowed in immediately. Exposure to air changes it to carbonate of lime and it becomes ineffective against finger and toe. This mistake was made at Cotleigh in 1929, when 30 cwt. of lime on ½ acre did not control the disease the following season. The limestone is, of course, beneficial to the soil and will reduce its lime deficiency, but it will not kill the Clubroot organism.

Hydrate of lime is a very convenient form to apply lime. It is purchased in 56 lb. paper bags and can be stored indefinitely. It is a fine powder, and so is easy to spread over the soil and to work in thoroughly without letting patches of soil escape treatment. It was used in an experiment near Kingsbridge in 1932.

The following analyses show how it affected the soil :—

Sample	pH.	Available Phosphate.	Available Potash.
Before treatment Feb. 25, 1932	6.25	.0274	.0136
Limed Plot, Aug. 4th	8.22	.054	.0060
Untreated, Aug. 4th	6.15	.036	.0221
Limed, Oct. 26th	8.02	.0455	.0134
Untreated, Oct. 26th	6.28	.0290	.0115

The quantity of hydrated lime used on a plot 100 x 24 ft. was at the rate of 1 ton per acre. It was applied on May 17th. The control of the disease was remarkably good. Almost every root was diseased in the untreated parts, and there were large bare patches. In the treated plot there were no gaps and every plant was healthy.

Hydrated lime was used at another centre, but no finger and toe disease appeared in the field.

Cabbage plants were grown in a series of pots containing soil from a diseased field near Kingsbridge. The pots were given different treatments. The seed was sown May 24th, 10 in each pot. The following observations were made on November 9th :—

		No. clean.	No. diseased.
Untreated.	Pot 1	0	6
	2	0	0
	3	2	3
	4	2	5
$CaCO_3$ (limestone)	Pot 1	0	4
	2	1	5
	3	5	0
	4	6	0
	5	4	0
$Ca(OH)_2$ (hydrate of lime)	Pot 1	3	0
	2	6	0
	3	4	0
	4	4	0
CaO (quicklime)	Pot 1	3	0
	2	7	0
	3	2	0
	4	3	0

The third series had the best plants with most root development.

EFFECT ON MANURING.

It is well known that the effects of finger and toe are less severe in a well-manured crop than in one growing in poorer soil. In Devon it is found that the severest losses are in the regions of unfertile soil, e.g., the reclaimed brake land around Blackawton, in South Devon. Many analyses have been made of soils affected with finger and toe, and there is a general indication that the disease tends to be most severe on the poorer soils, i.e., low in available phosphates, potash, and nitrates and short of lime. Liming is probably the cheapest method of control in these soils, and at the same time raises the level of fertility. Artificial fertilisers are difficult to apply without upsetting the balance of the soil. The usual result is an excess of phosphates, a phenomenon which is shown by the majority of finger and toe soils. There is, however, no simple relation with the intensity of the disease as the amount of infection will depend on the crop rotation and other factors.

Farmyard manure increases the fertility of the soil, but unless it is very well rotted it temporarily reduces the available nitrates, as these are being used up by the soil bacteria, which are acting upon the manure. From the point of view of finger and toe this would probably encourage the disease, which is favoured by low nitrates, i.e., temporarily low fertility. This was observed on a farm near Totnes, in which one half of a large field was dressed with dung and the rest with kainit. Although the soil analyses showed practically no difference (2321 and 2322 in table 1), the disease was abundant on both swedes and turnips in the dunged part and very small on swedes in the kainit part and moderate on the turnips.

The analyses of soils where finger and toe has occurred are set out in the following table, a careful study of which gives much information on the best manuring to be adopted. The first column is the reference number of the sample, the second column the date on which the sample was collected, and the next column the place. The other columns give the soil composition, first the hydrogen-ion figure (see explanation on p. 34), then the percentage of available phosphates and potash, and finally the nitrates in parts per million. The last figure varies according to the season, being higher in the summer than in the winter, but is a good indication of the general fertility of the soil. A good farm soil should have a figure not less than 10 in the summer and not less than 5 in the winter. The percentage of phosphates and of potash in Westcountry soils should be not less than 0.03%, and if the

phosphates are more than this, the potash should be higher, so that the proportion is the same. Practically all the soils in the table show either abnormally low figures or an excess of phosphates over potash. The most important principle in manuring is undoubtedly to try to correct this, and farmers are advised to have their fields analysed by the Advisory Chemist at Seale-Hayne College, to whom the writer is indebted for the results published here.

FINGER AND TOE IN SWEDES AND TURNIPS.

Sample	Date.	Place.	pH.	Phos-phates.	Pot-ash	Ni-trates
785	24/1/30	Veryan, Cornwall	5.17	.013	.013	—
1135	7/10/30	Staverton, Devon	6.92	—	—	—
1712	11/2/32	Cotleigh, Devon	5.23	.105	.020	6.2
1713	Do.	Do.	5.40	.051	.017	5.8
1724	15/2/32	Buckfastleigh, Devon	5.84	.018	.017	3.2
1725	Do.	Do.	6.60	.015	.011	3.3
1726	Do.	Do.	6.99	.022	.011	3.7
1727	Do.	Do.	7.37	.016	.007	3.8
1728	Do.	Do.	6.25	.013	.009	7.0
1766	25/2/32	Kingsbridge, Devon	6.25	.027	.014	9.4
1773	2/3/32	Loddiswell, Devon	4.79	.028	0.10	3.7
2197	4/8/32	Kingsbridge, Devon	6.15	.036	.022	17.4
2300	12/10/32	Buckfastleigh, Devon	6.42	.054	.024	6.2
2320	26/10/32	Totnes, Devon	7.30	.079	.012	7.8
2321	Do.	Do.	6.32	.033	.010	4.1
2322	Do.	Do.	6.11	.032	.015	4.6
2324	Do.	Kingsbridge, Devon	6.28	.029	.012	3.7
2335	28/10/32	Hennock, Devon	4.88	.056	.021	2.9
2336	Do.	Buckfastleigh, Devon	5.81	.011	.016	4.1
2554	11/11/32	Stoke Fleming, Devon	6.30	.035	.027	6.9
2355	Do.	Do.	6.20	.040	.017	6.5
2356	Do.	Diptford, Devon	6.16	.015	.015	6.6
2413	5/12/32	Ilsington, Devon	5.88	.054	.014	4.2
2424	10/12/32	Harberton, Devon	5.95	.015	.010	7.3
2489	24/1/33	Aveton Gifford, Devon	5.84	.019	.016	11.3
2491	Do.	Do.	6.21	.018	.011	12.9

FINGER AND TOE IN BROCCOLI, ETC.

Sample	Date	Place	pH	Phos-phates	Pot-ash	Ni-trates
1250	17/1/31	Hele, Devon	6.78	.028	.013	—
1369	11/5/31	Chagford, Devon	4.95	.025	.020	—
1567	21/10/31	Tamerton Foliot, Devon	5.48	.014	.028	34.8
1568	Do.	Do.	5.75	.018	.024	22.5
1687	23/1/32	Torpoint, Cornwall	6.50	.083	.020	4.4
1688	Do.	Do.	7.62	.106	.020	3.0
1689	Do.	Do.	6.69	.013	.029	6.8
1836	6/4/32	Cornwood, Devon	5.08	.049	.044	5.3
2365	16/11/32	Kennford, Devon	5.37	.044	.018	2.8
2366	Do.	Do.	5.95	.037	.033	3.8
2398	28/11/32	Do.	6.48	.033	.019	16.2
2408	1/12/32	Starcross, Devon	5.88	.011	.010	2.2

Some of the analyses given in the tables are of special interest. Sample 1773 is typical of some of the very poor soil in parts of South Devon, where finger and toe prevents good crops ever being grown, and 1766, 2197, 2321, 2324, 2354 are slightly better soils in the same area, but still much troubled by the disease. Number 2319 is from a small field which has been evidently over-manured, the phosphate figure being much too high. This fault will be observed in a great many of the samples and is a common feature of Devon soils, which is undoubtedly prejudicial to the healthy growth of the plant. Samples 1724 to 1728 were taken from the same field. The amount of finger and toe diminished across the field in the order of the samples, and was almost absent from where number 1728 was taken. It will be observed that the lime figure rises in the same direction and that the nitrates are significantly higher than the rest. The importance of this fact is not clearly understood, but a low nitrate figure implies low fertility and certainly seems to favour the incidence of finger and toe.

In market-garden soils we find the excess of phosphate still more pronounced as shown by most of the soils in the second table. Sample 2408 was from a broccoli field newly taken over and is evidently very poor soil, requiring liming and manuring. The crop here was a total loss, the plants being badly infected before the heads began to form.

TREATMENT WITH KAINIT.

The idea is entertained by some farmers that dressings of kainit may exert some degree of control on the disease in swedes. It is possible that both the potash and salt present in kainit are directly beneficial, but so far no definite data have been forthcoming. Two fields dressed in parts with kainit were observed in 1932, but the amount of disease was so small and irregular that no conclusions could be drawn. The effect of the potash in the soil analyses is shown below.

			Phos-		
1. Totnes. 26/10/32.		pH.	phate.	Potash.	Nitrate.
Kainit	No. 2320	7.30	.079	.012	7.8
Untreated	2319	7.09	.071	.046	7.1
2. Buckfastleigh. 28/10/32.					
Untreated	No. 2336	5.81	.011	.016	4.1
Kainit	2337	5.72	.012	.016	3.6

There was no change apparent in the second example, but at Totnes the potash content was considerably raised, though still not enough to balance the high phosphates.

TREATMENT WITH SALT.

Agricultural salt at the rate of 10 cwt. per acre is claimed to be beneficial against finger and toe, but again no conclusive evidence can be obtained. Trial plots were observed on six different farms, but the disease was absent from all the fields and no conclusions can be drawn. Soil analyses were obtained from three farms.

				Phos-		
1. Kingsbridge.	Date.	No.	pH.	phate.	Potash.	Nitrate.
Untreated	26/10/32	2326	7.32	.039	.009	6.8
Salt	4/ 8/32	2195	8.30	.061	.015	20.2
Do.	26/10/32	2327	7.78	.025	.011	7.4
	Salt was applied 20th May.					
2. Totnes.						
Untreated	4/8/32	2193	8.42	.105	.005	17.7
Salt	Do.	2191	8.13	.119	.010	7.6
3. Buckfastleigh.						
Untreated	28/10/32	2336	5.81	.011	.016	4.1
Salt	Do.	2338	5.70	.016	.016	5.4

Thus the only effect of the salt was to raise the alkalinity of the soil temporarily.

TREATMENT WITH CALCIUM CHLORATE.

Calcium chlorate is a valuable weed-killer, and might conceivably have important actions on the minute organisms that inhabit the soil, as well as perhaps directly on the finger and toe organism. To test this a plot 27 x 36 feet in dimensions was laid down in a swede field near Kingsbridge. Calcium chlorate was distributed on 25th February, 1932, at the rate of 4 cwt. per acre. All the plants came up, but looked unhealthy at the second hoeing. When the field was examined on October 26th there were only about 20 plants left, and these were not only much stunted, but also badly affected with finger and toe. The following analyses show the effect on the composition of the soil.

Sample.	Date.	pH.	Phosphate.	Potash.	Nitrate.
1766	25/ 2/32	6.25	.027	.014	9.4
2323	26/10/32	6.69	.039	.013	6.3

Sample 1766 was taken before the chlorate was applied. The treatment had no appreciable effect on the soil composition.

Some pot experiments with cabbage were carried out as part of the series of pot experiments described on p. 35. Each pot was treated with potassium chlorate on 5th March, 1932, at the same rate as the field plot. There were four pots, ten seeds in each pot. The seeds were sown on 24th May and all germinated and grew for a few weeks and then gradually died, before infection by finger and toe had time to take place.

Chlorate dressings cannot then be recommended for the control of finger and toe.

RELATION TO TIME OF SOWING.

The finger and toe organism can infect plants only in the seedling stage, and the soil must be sufficiently moist at the time. Because of this it is possible for healthy crops to be grown in contaminated soil, if one is lucky with the weather. An interesting example of this was provided in 1932 by a field at Stoke Fleming. The disease was exceedingly bad except in one part of the field which was not sown until 20th July, nearly a month later than the rest of the field. Ox Cabbage in the same field was also entirely free from club root. There was no reason to suppose that the soil in these parts was not infected, for in the previous root crop the disease had been present here as in the rest of the field. Another example was near South Brent in which charlock was badly at-

tacked in June, but the swedes sown later entirely escaped attack. In market gardens the disease may be bad in broccoli, autumn cabbage and sprouts, but is much less common on spring cabbage. It is also an observation of farmers that finger and toe need not be feared when the young swede plants are slow in their growth. This occurs in a season too dry for the fungus; in wet weather favourable to the fungus the plants grow quickly.

As unfortunately the weather cannot be forecasted it is not possible to regulate the time of sowing, and this method cannot be relied on for the practical control of finger and toe.

ROTATION OF CROPS.

It is well known that a long rest from cruciferous crops will eliminate the finger and toe disease from the soil. Many cases have been observed in South Devon where the disease was bad in swedes when the same crop was grown one or two years before. In other parts of the same field which grew mangolds the swedes were quite healthy. A somewhat different phenomen was shown by a field at Ilsington in 1932, in which swedes were badly diseased following mangolds but healthy following potatoes. Manurial differences may account for the occurrence, although soil analyses at the end of the season failed to show any difference.

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FUNGAL DISEASES OF DEVON AND CORNWALL.

The following are additions to the Lists of Diseases given in previous Annual Reports.

I.—DISEASES FOUND IN BOTH COUNTIES.

PULSE.

Broad Bean.

Rust (*Uromyces Fabae* (Pers.) de Bary).

VEGETABLES.

Lettuce.

Grey Mould (*Botrytis cinerea* Pers.)

Cucumber.

Physiological Damping-Off (Non-parasitic).

Tomato.

Blossom End Rot (Non-parasitic).

FRUIT.

Strawberry.

Leaf Scorch (*Marssonina Fragariae* (Sacc.) Kleb.)

FLOWERS.

Delphinium.

Black Blotch (*Bacterium Delphinii* Bryan).

Sweet Pea.

Streak (? Virus).

Violet.

Leaf Spot (*Phyllosticta Violae* Desm.)

II.—DISEASES FOUND ONLY IN DEVON.

CEREALS.

Wheat.

Glume Blotch (*Septoria nodorum* Berk.)

PASTURE.

Grass.

Snow Mould (*Fusarium nivale* (Fr.) Ces.)

FORAGE CROPS.

Kohl-rabi.

Finger and Toe (*Plasmodiophora Brassicae* Woron.)

VEGETABLES.

Broccoli.

Damping Off (*Pythium de Baryanum* Hesse).

Cucumber.

Gummosis (*Cladosporium cucumerinum* Ell. and Arth.)

FRUIT.

Apple.

Scald (Non-parasitic).

Peach.

Bud Canker (*Clasterosporium carpophilum* (Lev.) Aderh.)

FLOWERS.

Amaryllis Belladonna.

Leaf Scorch (*Stagonospora Curtisii* (Berk.) Sacc.)

Rose.

Grey Mould (*Botrytis cinerea* Pers.)

Violet.

Rust (*Puccinia Violae* (Schum.) DC.)

Smut (*Urocystis Violae* (Sow.) Fisch. v. Waldh.)

MISCELLANEOUS.

Elm.

Dutch Elm Disease (*Graphium Ulmi* Schw.)

Plane.

Leaf Scorch (*Gloeosporium nervisequum* (Fuck.) Sacc.)

III.—DISEASES FOUND ONLY IN CORNWALL.

VEGETABLES.

Tomato.

Spotted Wilt (Virus).

FLOWERS.

Calendula.

Mildew (*Erysiphe* sp ? *cichoracearum* DC.)

Seale-Hayne College Pamphlets.

Pamphlet 3. The Charlock Danger.
,, 4. The Feeding of Cows in Relation to Milk Production.
,, 5. Plants Poisonous to Stock and First Aid.
,, 6. Tariff of Analyses.
,, 7. Field Experiments for 1922. (Out of Print).
,, 8. Simple Farm Book-keeping for Income Tax Purposes. (Out of Print).
,, 9. Feeding Potatoes to Pigs.
,, 10. First Report on the Cost of Food in Milk Production in Devon and Cornwall. (Out of Print).
,, 11. Milk Tainting Plants and Some Stored Milk Troubles.
,, 12. Second Report on the Cost of Food in Milk Production in Devon and Cornwall.
,, 13. Variety Trial with Oats.
,, 14. Spotted Medick.
,, 15. Potato Variety Trials, 1924.
,, 16. First Annual Report of the Department of Plant Pathology.
,, 17. Cost of Milk Production. (3rd Report). (Out of Print).
,, 18. Potato Variety Trials, 1925.
,, 19. Second Annual Report of the Department of Plant Pathology.
,, 20. Potato Variety Trials, 1926.
,, 21. Third Annual Report of the Department of Plant Pathology.
,, 22. Purity of Strain in Red Clover.
,, 23. Economic Investigation of Devon and Cornish Farms.
,, 24. Variety Trials with Potatoes. Four years. (Final Report). (Out of Print).
,, 25. Fourth Annual Report of the Department of Plant Pathology.
,, 26. Grassland Management. (Out of Print).
,, 27. Report of Advisory Departments.
,, 28. Tables of Composition, Nutritive and Manurial Values of Food.
,, 29. Report on the Elimination from a Dairy Herd of Cows reacting to the Tuberculin Test.
,, 30. Fifth Annual Report of the Department of Plant Pathology.
,, 31. Sixth Annual Report of the Department of Plant Pathology.
,, 32. The Manufacture of Butter.
,, 33. Sugar Beet Costs in Devon and Cornwall.
,, 34. Guide to Exhibit at the World's Poultry Congress (1930).
,, 35. Clotted Cream.
,, 36. Seventh Annual Report of the Department of Plant Pathology.
,, 37. Eighth Annual Report of the Department of Plant Pathology.
,, 38. A Study of Livestock Movements in Cornwall and Devon.
,, 39. Bacillary White Diarrhoea of Poultry.

June, 1933.

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